Amendments to the Claims

This listing of claims will replace all prior versions and listings of claims in the application:

1. (original) A method of modulating a three-phase three-level power converter comprising a first, a second and a third voltage source, each voltage source being configured to output a time-varying signal and being inductively coupled to a separate input node, each input node being connectable to a first output node, a second output node and a third output node, the converter further comprising a first capacitive element coupled between the first and the second output nodes and a second capacitive element coupled between the second output node and the third output node, wherein each time-varying voltage signal has substantially the same period and a different phase, the method comprising:

determining which voltage signal has the highest voltage, the lowest voltage and the intermediate voltage higher than one of the voltage signals and lower than the other voltage signal for each of a plurality of sub-periods;

connecting the voltage signal having the intermediate voltage to only the first output node during each sub-period;

connecting the voltage signal having the highest voltage to one of the second or third output nodes during each sub-period; and

connecting the voltage signal having the lowest voltage to one of the second or third output nodes during each sub-period.

2. (original) The method of claim 1, wherein the input node of the first voltage source is connectable to the first output node with a first switching element, to the second output node with a second switching element and to the third output node with a third switching element, the input node of the second voltage source is connectable to the first output node with a fourth switching element, to the second output node with a fifth switching element and to the third output node with a sixth switching element, and the input node of the third voltage source is connectable to the

first output node with a seventh switching element, to the second output node with an eighth switching element and to the third output node with a ninth switching element.

3. (original) The method of claim 2, wherein the period of the time-varying voltage signals is dividable into six substantially equal sub-periods.

4. (original) The method of claim 3, further comprising connecting the first second and third voltage signals such that the voltage at the second output node is the voltage of the signal having the highest voltage and the voltage at the third output node is the voltage of the signal having the lowest voltage.

5. (original) The method of claim 2, further comprising providing a universal controller configured to generate a plurality of drive signals, each drive signal configured to control a switching element.

6. (original) The method of claim 1, wherein the universal controller comprises an average current mode control core.

7. (original) The method of claim 1, wherein the universal controller comprises a current mode control core.

8. (original) The method of claim 1, wherein the universal controller comprises a sliding mode control core.

9. (original) A method of modulating a three-phase three-level power converter, comprising:

providing a power converter comprising a first, a second and a third voltage source each configured to output a time-varying signal, the first and second voltage sources each being inductively coupled to a separate input node, the output nodes being connectable to a first and second output node, and the third voltage source being inductively coupled to a third output node, the power converter further comprising a first capacitive element coupled between the first and the second output node, and a second capacitive element coupled between the second output node and the third output node,

wherein each time-varying voltage signal has substantially the same period and a different phase; and

providing a controller configured to control the connection of the second and third voltage sources to the second and third output nodes.

10. (original) The method of claim 9, wherein the input nodes are connectable to the first and second output nodes with a plurality of switching elements.

11. (original) The method of claim 9, wherein the universal controller comprises a one-cycle control core.

12. (original) The method of claim 9, wherein the universal controller comprises an average current mode control core.

13. (original) The method of claim 9, wherein the universal controller comprises a current mode control core.

14. (original) The method of claim 9, wherein the universal controller comprises a sliding mode control core.

15. (original) A method of modulating a three-phase three-level power converter comprising a first, a second and a third voltage source, each voltage source being configured to output a time-varying signal and being inductively coupled to a separate input node, each input node being connectable to a first output node, a second output node and a third output node, the converter further comprising a first capacitive element coupled between the first and the second output node and a second capacitive element coupled between the second output node and the third output node, wherein each time-varying voltage signal has substantially the same period and a different phase, the method comprising:

determining which voltage signal has the highest voltage, the lowest voltage and the intermediate voltage higher than one of the voltage signals and lower than the other voltage signal for each of a plurality of sub-periods;

determining which voltage signal is dominant for each of the plurality of sub-periods;

connecting the voltage signal having the lowest voltage to only the third output node when the dominant voltage signal is lower than the non-dominant voltage signals;

connecting the voltage signal having the highest voltage to one of the first output node and the second output node during each sub-period where the dominant voltage signal is lower than the non-dominant voltage signals;

connecting the voltage signal having the intermediate voltage to one of the second output node and the third output node during each sub-period where the dominant voltage signal is lower than the non-dominant voltage signals;

connecting the voltage signal having the highest voltage to only the second output node when the dominant voltage signal is higher than the non-dominant voltage signals;

connecting the voltage signal having the lowest voltage to one of the first output node and the second output node during each sub-period where the dominant voltage signal is higher than the non-dominant voltage signals; and

connecting the voltage signal having the intermediate voltage to one of the second output node and the third output node during each sub-period where the dominant voltage signal is higher than the non-dominant voltage signals.

16. (original) The method of claim 15, wherein the input nodes are connectable to the first and second output nodes with a plurality of switching elements.

17. (currently amended)The method of claim [17] 16, further comprising providing a universal controller configured to control the plurality of switching elements.

18. (original) The method of claim 17, wherein the universal controller comprises a one-cycle control core.

19. (original) The method of claim 15, wherein the universal controller comprises an average current mode control core.

20. (original) The method of claim 15, wherein the universal controller comprises a current mode control core.

21. (original) The method of claim 15, wherein the universal controller comprises a sliding mode control core.

22. (original) The method of claim 16, wherein the input node of the first voltage source is connectable to the first output node with a first switching element, to the second output node with a second switching element and to the third output node with a third switching element, the input node of the second voltage source is connectable to the first output node with a fourth switching element, to the second output node with a fifth switching element and to the third output node with a sixth switching element, and the input node of the third voltage source is connectable to the first output node with a seventh switching element, to the second output node with an eighth switching element and to the third output node with a ninth switching element.

23. (original) The method of claim 22, wherein the period of the time-varying voltage signals is dividable into twelve substantially equal sub-periods.

24. (original) A three phase two level universal controller, comprising:

a one cycle control (OCC) core configured to generate a plurality of drive signals;

a region selection unit configured to monitor a first, second and third time-varying voltage signal, each voltage signal having a different phase, and configured to determine a region of operation based on each of the time-varying signals;

a signal selection unit coupled with the region selection unit and the OCC core and configured to select one or more input signals based on the region of operation and provide the selected signals to the core; and

a drive signal distribution unit coupled to the OCC core and the region selection unit, the drive signal distribution unit configured to distribute the drive signals to a static volt-ampere-reactive (VAR) compensator (SVC), wherein the drive signals are configured to control a plurality of switching elements in the SVC.

25. (original) The universal controller of claim 24, further comprising a reference signal source unit configured to provide a reference signal to the control core.

26. (original) The universal controller of claim 25, wherein the signal selection unit is configured to combine the reference signal with each of the time varying voltage signals and select one or more input signals from the combined signals.

27. (original) A three phase three level universal controller, comprising:

a one cycle control (OCC) core configured to generate a plurality of drive signals;

a region selection unit configured to monitor a first, second and third main time-varying voltage signal, each voltage signal having a different phase, and configured to determine a region of operation based on each of the main signals;

an signal selection unit coupled with the region selection unit and the OCC core and configured to select one or more input signals based on the region of operation and provide the selected signals to the core; and

a drive signal distribution unit coupled to the OCC core and the region selection unit, the drive signal distribution unit configured to distribute the drive signals to an active power filter (APF), wherein the drive signals are configured to control a plurality of switching elements in the APF.

28. (original) The universal controller of claim 27, further comprising a reference signal source unit configured to provide a reference signal to the control core.

29. (original) The universal controller of claim 28, wherein the signal selection unit is configured to combine the reference signal with each of the time varying voltage signals and select one or more input signals from the combined signals.

30. (original) A three phase three level universal controller, comprising:

a one cycle control (OCC) core configured to generate a plurality of drive signals;

a region selection unit configured to monitor a first, second and third main time-varying voltage signal, each voltage signal having a different phase, and configured to determine a region of operation based on each of the main signals;

an signal selection unit coupled with the region selection unit and the OCC core and configured to select one or more input signals based on the region of operation and provide the selected signals to the core; and

a drive signal distribution unit coupled to the OCC core and the region selection unit, the drive signal distribution unit configured to distribute the drive signals to an grid connected inverter (GCI), wherein the drive signals are configured to control a plurality of switching elements in the GCI.

31. (original) The universal controller of claim 30, further comprising a reference signal source unit configured to provide a reference signal to the control core.

32. (original) The universal controller of claim 31, wherein the signal selection unit is configured to combine the reference signal with each of the time varying voltage signals and select one or more input signals from the combined signals.

33. (original) A three phase three level universal controller, comprising:

a one cycle control (OCC) core configured to generate a plurality of drive signals;

a region selection unit configured to monitor a first, second and third main time-varying voltage signal, each voltage signal having a different phase, and configured to determine a region of operation based on each of the main signals;

an signal selection unit coupled with the region selection unit and the OCC core and configured to select one or more input signals based on the region of operation and provide the selected signals to the core; and

a drive signal distribution unit coupled to the OCC core and the region selection unit, the drive signal distribution unit configured to distribute the drive signals to an SVC converter, wherein the drive signals are configured to control a plurality of switching elements in the SVC converter.

34. (original) The universal controller of claim 33, further comprising a reference signal source unit configured to provide a reference signal to the control core.

35. (original) The universal controller of claim 34, wherein the signal selection unit is configured to combine the reference signal with each of the time varying voltage signals and select one or more input signals from the combined signals.

36. (original) A method of modeling a power converter system, comprising:

determining a phase offset value and a gain value for a reference signal, wherein the reference signal is input to a controller model configured to control a power converter;

modeling the reference signal by applying the determined phase and gain values into the formula

$$\begin{bmatrix} i_{aref} \\ i_{bref} \\ i_{cref} \end{bmatrix} = G_e \cdot e^{j \cdot \theta} \begin{bmatrix} v_a \\ v_b \\ v_c \end{bmatrix}$$

where:

G_e is the gain value, θ is the phase offset value, V_a, V_b and V_c are input signals to the power converter and i_{aref}, i_{bref} and i_{cref} are the reference signals corresponding to V_a, V_b and V_c; and

modeling the controller with the reference signal generated by the formula.

37. (original) A three phase three level universal controller, comprising:

a one cycle control (OCC) core configured to generate a plurality of drive signals, the OCC core comprising:

a signal adjustment unit configured to condition a plurality of input signals and output a first and a second conditioned signals;

an integrator configured to integrate an output voltage signal from a power converter and output an integrated signal;

a first and a second comparator each communicatively coupled with the integrator and the signal adjustment unit, the first comparator configured to compare the first conditioned signal with the integrated signal and output a first compared signal and the second comparator configured to compare the second conditioned signal with the integrated signal and output a second compared signal;

a first flip-flop communicatively coupled with the first comparator and a clock signal generator and configured to output a first drive signal; and

a second flip-flop communicatively coupled with the first comparator and a clock signal generator and configured to output a second drive signal, wherein the first and second drive signals are configured to directly control the power converter independent of an operating region of the power converter.

38. (original) The controller of claim 37, wherein the first flip-flop and second flip-flops are S/R flip-flops.

39. (original) The controller of claim 37, wherein the drive signals are configured to control a power converter comprising:

a first voltage source configured to output a first time-varying signal, wherein the first voltage source is inductively coupled to a first input node;

a first switching element coupled between the first input node and a first output node;

a second switching element coupled between the first input node and a second output node;

a third switching element coupled between the second input node a the first output node;

a fourth switching element coupled between the second input node and the second output node;

a first capacitive element coupled between the first and the second output node; and

a second capacitive element coupled between the second output node and a third output node, wherein the third voltage source is inductively coupled with the third output node and each time-varying voltage signal has substantially the same period and a different phase.

40. (original) A three phase three level universal controller, comprising:

a one cycle control (OCC) core configured to generate a plurality of drive signals, the OCC core comprising:

a signal adjustment unit configured to condition a plurality of input signals and output a first and a second conditioned signals;

a first integrator configured to integrate an output voltage signal from a power converter and output a first integrated signal;

a second integrator configured to integrate the output voltage signal from the power converter and output a second integrated signal;

a first comparator communicatively coupled with the second integrator and the signal adjustment unit, the first comparator configured to compare the first conditioned signal with the second integrated signal and output a first compared signal;

a second comparator communicatively coupled with the first integrator and the signal adjustment unit, the second comparator configured to compare the second conditioned signal with the first integrated signal and output a second compared signal;

a first flip-flop communicatively coupled with the first comparator and a clock signal generator and configured to output a first drive signal; and

a second flip-flop communicatively coupled with the first comparator and a clock signal generator and configured to output a second drive signal, wherein the first and second drive signals are configured to control the power converter.

41. (original) The controller of claim 40, wherein the first flip-flop and second flip-flops are S/R flip-flops.

42. (original) The controller of claim 41, further comprising:

a region selection unit configured to monitor a first, second and third time-varying voltage signal, each voltage signal having a different phase, and configured to determine a region of operation based on the three time-varying voltage signals;

an signal selection unit coupled with the region selection unit and the OCC core and configured to select a plurality of input signals based on the region of operation and provide the selected input signals to the core; and

a drive signal distribution unit coupled to the OCC core and the region selection unit, the drive signal distribution unit configured to distribute the drive signals to the power converter, wherein the drive signals are configured to control a plurality of switching elements in the power converter.

43. (original) A method of generating a reference signal for a power converter to stabilize performance over a range of load conditions, comprising:

scaling down a first, second and third main line voltage signal, wherein each voltage signal has a different phase;

inputting these scaled down signals as reference signals to a power converter; and

operating the power converter.

44. (original) The method of claim 43, wherein the first, second and third main line voltage signals are scaled down from the voltage signal levels present under a substantial load.

45. (original) The method of claim 43, wherein the power converter is a power factor corrected (PFC) rectifier.

46. (original) The method of claim 43, wherein the power converter is an active power filter (APF).

47. (original) The method of claim 43, wherein the power converter is a static volt-ampere-reactive (VAR) compensator (SVC).

48. (original) A method of modulating a switching frequency in a power converter, comprising:

providing a controller configured to control a power converter having a nonlinear load having a load level, wherein the controller has an input voltage switching frequency;

changing the switching frequency in response to a change in the load level of the power converter, wherein the switching frequency is increased when the load level decreases and the switching frequency is decreased when the load level is increased.